Having described the preferred embodiments, the invention is now claimed to be:

1. A magnetic resonance imaging system including:

a means (10) for encoding magnetic resonance in at least a readout direction, the encoding including applying a read magnetic field gradient profile;

a plurality of receive coils (14) for receiving magnetic resonance signals;

a sampling means (16) for sampling the receive coils during application of the read magnetic field gradient profile to acquire samples from each receive coil at a measurement sampling rate;

a means (30) for reconstructing the magnetic resonance samples acquired from each coil into a corresponding intermediate reconstructed image, the intermediate reconstructed images having a measurement field of view and a measurement spatial resolution in the readout direction; and

a means (40) for combining the intermediate reconstructed images based on coil sensitivity factors (42) to produce a final reconstructed image having a final field of view and a final spatial resolution in the readout direction, wherein at least one of the final field of view and the final spatial resolution is increased over a corresponding one of the measurement field of view and the measurement spatial resolution in the readout direction.

2. The magnetic resonance imaging system as set forth in claim 1, further including:

a coils sensitivities processor (46) that computes coils sensitivities data based on a calibration image.

3. The magnetic resonance imaging system as set forth in claim 2, wherein the combining means (40) solves a set of linear equations relating pixel values of the intermediate reconstructed images and coils sensitivities data computed by the coils sensitivities processor (46) to compute a pixel value of the final reconstructed image.

4. The magnetic resonance imaging system as set forth in claim 1, wherein the means (10) for encoding magnetic resonance includes:

a magnetic resonance imaging scanner (10) that encodes magnetic resonance samples in both phase encode and readout directions.

5. The magnetic resonance imaging system as set forth in claim 4, wherein the sampling means (16) also acquires magnetic resonance samples encoded in the phase encode direction, the magnetic resonance imaging scanner (10) and the receive coils (14) cooperating to effect sensitivity encoding in the phase encode direction.

6. The magnetic resonance imaging system as set forth in claim 4, wherein the sampling means (16) also acquires magnetic resonance samples encoded in the phase encode direction, the magnetic resonance imaging scanner (10) and the receive coils (14) cooperating to effect variable density sensitivity encoding in the phase encode direction.

7. The magnetic resonance imaging system as set forth in claim 4, wherein:

the magnetic resonance signals are encoded in the phase encode direction, and the sampling means (16) acquires samples that are encoded in the phase encode direction and the readout direction with a sufficiently low sampling density that the intermediate reconstructed images are aliased in each of the phase encode direction and the readout direction; and

the combining performed by the combining means (40) unfolds the intermediate reconstructed images in both the phase encode direction and the readout direction to produce the final reconstructed image with the aliasing removed.

8. The magnetic resonance imaging system as set forth in claim 4, wherein:

the sampling means (16) samples the receive coils (14) to read the magnetic resonance samples over a shortened read gradient profile such that the reconstructing means (30) produces the intermediate reconstructed images with degraded measurement spatial resolution in the readout direction compared with the final spatial resolution in the readout direction;

the sampling means (16) samples the receive coils (14) at a sampling rate in the phase encode direction which is sufficiently low such that the reconstructing means (30) produces the intermediate reconstructed images with aliasing in the phase encode direction; and

the combining performed by the combining means (40) produces the final reconstructed image with both the spatial resolution degradation in the readout direction and the aliasing in the phase encode direction removed.

9. The magnetic resonance imaging system as set forth in claim 1, wherein:

the sampling means (16) acquires samples in the readout direction that map to low frequency readout values of a k-space and not to higher frequency readout values of the k-space.

10. The magnetic resonance imaging system as set forth in claim 9, wherein the sampling means (16) samples the low frequency readout values of the k-space over a shortened read gradient profile.

11. The magnetic resonance imaging system as set forth in claim 1, wherein the sampling means (16) undersamples the receive coils (14) at a reduced sampling rate such that the intermediate reconstructed images include aliasing in at least the readout direction, the combining means (40) removing said aliasing during the combining.

12. The magnetic resonance imaging system as set forth in claim 11, wherein the sampling means (16) performs the undersampled receiving using a sampling time for each sample that is greater than a minimum sampling time for sampling at a maximum readout sampling rate.

13. The magnetic resonance imaging system as set forth in claim 1, wherein the measurement sampling rate is sufficiently low that aliasing occurs in the intermediate reconstructed images in the readout direction, and the means (40) for combining unfolds the intermediate reconstructed images based on the coil sensitivity factors (42) to remove the aliasing in the readout direction, the final field of view being increased over the measurement field of view.

14. The magnetic resonance imaging system as set forth in claim 1, wherein the read magnetic field gradient profile is shortened such that the measurement spatial resolution is less than the final spatial resolution, and the means (40) for combining implements an inverting of a sensitivity matrix constructed from the coil sensitivity factors (42).

15. The magnetic resonance imaging system as set forth in claim 1, wherein each intermediate reconstructed image has degraded high spatial frequency characteristics due to reduced sampling in the readout direction, and the combining performed by the combining means (40) restores the high spatial frequency characteristics in the final reconstructed image.

16. The magnetic resonance imaging system as set forth in claim 15, wherein:

the degraded high spatial frequency characteristics in the readout direction include aliasing and a reduced field of view in the readout direction.

17. A magnetic resonance imaging method including:

encoding magnetic resonance signals in at least a readout direction with a read magnetic field gradient profile;

sampling the magnetic resonance signals in the readout direction using a plurality of receive coils (14) to acquire magnetic resonance samples from each coil at a measurement sampling rate;

reconstructing the magnetic resonance samples acquired from each coil (14) into a corresponding intermediate reconstructed image, the reconstructed images having a measurement field of view and a measurement spatial resolution in the readout direction; and

combining the intermediate reconstructed images based on coil sensitivity factors (42) to produce a final reconstructed image having a final field of view and a final spatial resolution in the readout direction, wherein at least one of the final field of view and the final spatial resolution is increased over a corresponding one of the measurement field of view and the measurement spatial resolution in the readout direction.

18. The magnetic resonance imaging method as set forth in claim 17, wherein the encoding of magnetic resonance signals includes:

encoding the magnetic resonance signals using transmit SENSE.

19. The magnetic resonance imaging method as set forth in claim 17, wherein the combining based on the coils sensitivities (42) produces a final reconstructed image having a higher spatial frequency content in the readout direction than any one of the intermediate reconstructed images.

20. The magnetic resonance imaging method as set forth in claim 19, wherein the high spatial frequency content of the final reconstructed image is generated during the combining by transforming aliasing in the readout direction of the intermediate reconstructed images into image data outside a field of view of the intermediate reconstructed images.

21. The magnetic resonance imaging method as set forth in claim 17, wherein the sampling includes at least one of:

sampling over a shortened read magnetic field gradient profile such that the combining restores resolution in the readout direction; and

sampling at a reduced sampling rate such that the combining restores field of view in the readout direction.